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ERGONOMIC CONSIDERATION OF THE EFFECT OF FLOUR DUST ON PEAK EXPIRATORY FLOW RATE OF BAKERS IN ABEOKUTA, OGUN STATE

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Research article

Abstract: Flour dusts are one of the most harmful chemicals in the bakery industries which could lead to serious heart and lung diseases. This study investigated the effect of flour dust on Peak Expiratory Flow Rate of male bakers in Abeokuta, Ogun State, Nigeria with the relationship to the anthropometrical parameters. A total of One hundred Eighty (180) male participants were investigated, where ninety (90) participants were bakers and ninety (90) individuals as control group. The Peak expiratory flow rate (PEFR) and anthropometrical parameters of the participant were measured using mini-Wright peak flow meter (PFM 20, OMRON) and Detecto PD300MDHR (Cardinal Scale manufacturing company, USA) column scale with digital height rod was used to measure body mass [kg] and height (cm) respectively. The PEFR and anthropometrical parameters of the bakers and control groups were analysed using descriptive statistics and T-test with SPSS. The results showed that lower PEFR, 182.67 ± 16.34 L/min existed in bakers compared to 287.67 ± 17.02 L/min in the control study. The result also showed that a significant correlation exist between body mass, height and age ($P < 0.01$), PEFR, height ($P < 0.05$) and years of exposure ($P < 0.01$) of the bakers respectively. Furthermore, the results also showed that workers in the dusting and mixing of flour are at a risk of developing related pulmonary function impairment such as asthma. The study concluded that there is need to develop an effective intervention strategy, treatment seeking behaviour through awareness programs to prevent lung impairment diseases among the bakery workers.

Keywords: Bakery, flour dust, workers, peak expiratory flow rate, eposure.

Introduction

Flour dust is a complex organic dust consists of wheat, rye, millet, oats, corn or combination of these, which have been processed or grounded by milling. Wheat is the most common grains used to make flour. These flours vary in weight, compressibility and moisture content. The typical composition of wheat flour is 14 % protein, 2 % oil, 1 % cellulose and 81 % non-nitrogenous materials. Flour dust consists of particles ranging from as small as 1micron meter to the greater than 20 micron meter.

It causes symptoms throughout the respiratory tract, ranging from rhinitis in the nasal area to chronic bronchitis and asthma in the lungs. Ige and Awoyemi (2002) investigated the occupational induced long function impairment in bakery workers as a result of exposure to grain and flour dust. They reported that the mean values of peak expiratory flow rate (PEFR) in the bakery workers are significantly lower than those of the control subject. Yach et al (1985) found that the grain mill workers had significant deteriorated lung function values compared to their matched control. Essen (1997) demonstrated that the grain dust exposure is a common cause of respiratory symptoms and these workers developed obstructive change on pulmonary testing. Zuskin et al (1998) suggested that workers employed in the processing of flour may be at a risk in the development of respiratory impairment.

Flour dust causes deterioration of lung function in the subjects working at rice mills and this deterioration increased with duration of exposure (Itagi et al, 2011). Shamssain (1995) found that

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mean percent predicted values for PEFR were lower in the bakery workers compared to control groups. Chen (1992) divided the bakers into high and low exposure groups and observed that PEFR are significantly reduced in the highly exposed groups. A case control study to analyse the effects of exposure to flour dust on lung function of bakery workers in Sudan revealed significantly reduction in PEFR percent predicted in bakery workers who worked for more than three years compared to control (Ahmed et al, 2009). Various studies highlighted above have shown decline in lung functions with chronic exposure to dust. Further decline in lung function was directly proportional to the duration of exposure.

Abou Taleb et al, (1995) and Rafnsson et al, (1997) reported that the normal values for Peak expiratory flow rate for an healthy adult and non-exposed to dust is between 300 - 600 L/min with variation for age, body mass, height, and gender. Similarly Vestbo et al, (1991) also found that the most appropriate values for healthy and non-exposed to dust adult males and female are from 400 - 600 L/min and 300 - 500 L/min respectively.

Elebute and Femi-Pearse (1971) performed a study to establish the standard values of Peak expiratory flow rate (PEFR) in Nigeria where they measure the anthropometric parameters and PEFR of 142 healthy subjects. The study revealed that the mean values of male PEFR were 482.1 L/min (± 83.3) and 385.6 L/min (± 65.7) for female. Based on the study conducted by Elebute and Femi-Pearse(1971) that was taking as outdated, prompted the present research to revalidated their findings. The aim of this present research is to determine the effect of flour dust on peak expiratory flow rate of bakers with respect to their level of exposure to the flour dusts.

Materials and method

This study investigated the effect of flour dust on peak expiratory flow rate of Male bakers in Abeokuta, Ogun State, Nigeria and the relationship between the peak expiratory flow rate and the demographical parameters. A total of One hundred Eighty (180) male participants were investigated, where ninety (90) participants were bakers whose age ranged from 22 - 35 years and they have involved in the mixing of flour business between 6 months and 8 years and ninety (90) individuals as control group.

These control groups were of the same age group with the bakers and there mostly artisans and students recruited within Abeokuta metropolis. Both the bakers and the control groups had no earlier report of systematic diseases. Subject suffering from any respiratory illness and smoking were exempted from the study.

The structured questionnaire was also used as a tool of data collection which includes the details demographic data of the subject such as age, marital status, education level, smoking habit, duration of flour dust exposure, working experience in the bakery industries and the occupational health hazards.

Detecto PD300MDHR (Cardinal Scale manufacturing company, USA) column scale with digital height rod was used to measure body mass [kg] and height [cm] of the subjects simultaneously. The peak expiratory flow rate (PEFR) was measured with mini-Wright peak flow meter, PFM 20 (OMRON). Three readings were taken from each subject in standing position and the best of the three were considered as peak expiratory flow rate reading for that subject. Fig. 1 showed subject (Baker) performing measurement of PEFR using mini-Wright peak flow meter, PFM 20 (OMRON) while fig. 2 showed subject performing anthropometrical measurement of Body mass and Height with Standiometer

Data collected were analysed statistically with the new version of SPSS Version 17.0 and Microsoft Excel (2010) software.

Tab. 1 Descriptive statistics for Bakers

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Body mass [kg]	90	52.8	69.3	61.508	0.4201	3.9851
Height [cm]	90	161.4	177.2	170.184	0.3953	3.7501
PEFR [L/min]	90	160.0	220.0	182.667	1.7223	16.3391
Age [yrs]	90	25	34	28.04	0.260	2.467
Yrs of Exposure	90	1	4	2.50	0.079	0.753
Valid N [listwise]	90					

Safety Engineering Series DOI 10.1515/tvsbses-2017-0003

Results and discussions

The results obtained were expressed as mean ± standard deviation statistical techniques like T-test for two group comparisons, correlations analysis were considered.

Tab. 1 to Tab. 4 showed the descriptive statistics and T-tests analysis of bakers and the control groups respectively.

Tab. 1 showed that the minimum and maximum peak expiratory flow rate (PEFR) was 160 L/min and 220 L/min for bakers whose age were between 25 - 34years with average mean of the PEFR is 182.67 ± 16.34 L/min. Abou Taleb et al (1995) and Rafnsson et al (1997) presented in their research that the normal values of PEFR for healthy adults is between 300 - 600 L/min. Vestbo et al (1991) also presented that the normal values for healthy adults male and female is between 400 - 600L/min and 300-500L/min respectively.

In this present research, it was found that PEFR values for bakers were lower than the normal values (Abou Taleb et al, 1995; Rafnsson et al, 1997; Vestbo et al, 1991) and this showed that these bakers are not healthy and they were adjudged to have some degree of airflow obstruction.

Tab. 2 showed that the average mean values of PEFR for the control subjects are between 287.67 ± 17.03 L/min with 250 L/min and 330 L/min as the minimum and maximum peak expiratory flow rate (PEFR). The values generated from the present study for the control groups were in line with Abou Taleb et al, (1995) and Rafnsson et al, (1997) values.

This research found the difference in values of peak expiratory flow rate (PEFR) between the bakers and the control subjects in relation to height body mass and age, most especially in respect to height. However, the factors that determine PEFR are predominantly expiratory muscle effort, lung elastic

Tab. 2 Descriptive statistics for Control groups

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	**Statistic**	**Statistic**	**Statistic**	**Std. Error**	**Statistic**
Body mass [kg]	90	56.4	74.4	65.811	0.4837	4.5885
Height [cm]	90	159.9	180.1	170.904	0.4538	4.3050
PEFR [L/min]	90	250.0	330.0	287.667	1.7951	17.0294
Age [yrs]	90	22	35	27.97	0.327	3.107
Valid N [listwise]	90					

Tab. 3 T-test (one sample test) for Bakers

	Test Value = 0					
					99.99 % Confidence Interval of the Difference	
	t	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Lower**	**Upper**
Body mass [kg]	146.422	89	0.000	61.5078	59.796	63.219
Height [cm]	430.523	89	0.000	170.1844	168.574	171.795
PEFR [L/min]	106.060	89	0.000	182.6667	175.650	189.684
Age [yrs]	107.829	89	0.000	28.044	26.98	29.10
Years of Exposure	31.485	89	0.000	2.500	2.18	2.82

Tab. 4 T-test (one sample test) for Control groups

	Test Value = 0					
					99.99 % Confidence Interval of the Difference	
	T	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Lower**	**Upper**
Body mass [kg]	136.065	89	0.000	65.8111	63.840	67.782
Height [cm]	376.618	89	0.000	170.9044	169.056	172.753
PEFR [L/min]	160.255	89	0.000	287.6667	280.353	294.980
Age [yrs]	85.405	89	0.000	27.967	26.63	29.30

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recoil pressure and airway size (Primhak, et al, 1984). These muscle efforts depend on the physical strength activity. The findings of lower PEFR values in the bakers compared to control groups compares favourably with findings in similar studies in different industries for example Soap and detergent workers (Bamidele, 2000), detergent workers (Oleru, 1984), Wood furniture workers (Jinadu, 1998), and petrol workers (Sofola et al, 2005). These researchers drew their unexposed control subjects from outside their industries studied.

Tab. 5 showed that correlation is significant between PEFR and height of bakers ($P < 0.05$) and also occurred between the PEFR and years of exposure of male ($P < 0.01$). This revealed that the peak expiratory flow rate (PEFR) is practically dependent on the height and years of exposure of the bakers. Inem et al, (2010) research showed a similar inference in the present study as the level of Exposure do affects the PEFR which affect the lung function and leading to the degree of airflow obstruction and reduction in the peak expiratory

Tab. 5 Correlation coefficient for Bakers

		Body mass	**Height**	**PEFR**	**Age**	**Years of Exposure**
Body mass	Pearson Correlation	1	0.592**	-0.173	0.319**	0.074
	Sig. (2-tailed)		0.000	0.103	0.002	0.489
	N	90	90	90	90	90
Height	Pearson Correlation	0.592**	1	-0.236*	0.158	0.214*
	Sig. (2-tailed)	0.000		0.025	0.138	0.042
	N	90	90	90	90	90
PEFR	Pearson Correlation	-0.173	-0.236*	1	0.042	-0.539**
	Sig. (2-tailed)	0.103	0.025		0.697	0.000
	N	90	90	90	90	90
Age	Pearson Correlation	0.319**	0.158	0.042	1	-0.042
	Sig. (2-tailed)	0.002	0.138	0.697		0.692
	N	90	90	90	90	90
Years of Exposure	Pearson Correlation	0.074	0.214*	-0.539**	-0.042	1
	Sig. (2-tailed)	0.489	0.042	0.000	0.692	
	N	90	90	90	90	90

** Correlation is significant at the 0.01 level (2-tailed).

Tab. 6 Correlation coefficient for Control groups

		Body mass	**Height**	**PEFR**	**Age**
Body mass	Pearson Correlation	1	0.153	0.549**	-0.427**
	Sig. (2-tailed)		0.149	0.000	0.000
	N	90	90	90	90
Height	Pearson Correlation	0.153	1	0.331**	0.071
	Sig. (2-tailed)	0.149		0.001	0.506
	N	90	90	90	90
PEFR	Pearson Correlation	0.549**	0.331**	1	-0.133
	Sig. (2-tailed)	0.000	0.001		0.211
	N	90	90	90	90
Age	Pearson Correlation	-0.427**	0.071	-0.133	1
	Sig. (2-tailed)	0.000	0.506	0.211	
	N	90	90	90	90

** Correlation is significant at the 0.01 level (2-tailed).

flow rate. Inem et al, (2010) also discovered that increase in PEFR also increases with the height of the workers as it appeared in this study.

Tab. 6 showed that a significant correlation existed between the PEFR and the height of the control subject ($P < 0.01$) having a strong positive correlation with height. Ele (1992) presented that height is a good indicator of body build, hence, there is always a good correlation between height and ventilator function as it was found in this present study. There was no disagreement regarding positive correlation of PEFR with height as independent body parameters. Standing height is the best predictor of PEFR (Wall et al, 1982) and height should have the first preference for prediction of PEFR because of more accuracy, easy measurable at any palace and it's highly significant relationship with PEFR. The PEFR [L/min] values in relation to height interval in the present study were comparable to those obtained in other studies (Benjaponpitak et al, 1999; Host et al, 1994) and it was similar to the values obtained in this present study.

Conclusion

The positive coefficient of peak expiratory flow rate (PEFR) with body mass, height, age and years of exposure (where applicable) was observed in both the bakers and control subject this signifies that the values of PEFR increases with increased anthropometric parameters.

In conclusion, the study has revealed a very high prevalence of respiratory symptoms and occupational asthma among bakers as a result of lower PEFR. The key determinant of increased lung function in this study was long duration of flour dust exposure, poor use of personal protective equipment (PPE). The use and education of PPE should be encourage and promoted as it has been shown to significantly reduce the risk of lung function impairment. Further study is also required to understand the difference of peak expiratory flow rate between female and male baker. This can also be extended to between the flour dust exposed and non-exposed workers.

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Safety Engineering Series DOI 10.1515/tvsbses-2017-0003

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